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FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study has been prepared to revise and update a previous Flood Insurance Rate Map for the City of Point Arena, Mendocino County, California. This information will be used by Point Arena to update existing flood plain regulations as part of the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). The information will also be used by local and regional planners to further promote sound land use and flood plain development.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The coastal hazard analyses for this study were performed by Ott Water Engineers, Inc., for FEMA, under Contract No. EMW-83-C-1175. This work was completed in August 1984.

1.3 Coordination

Coastal areas requiring detailed study were identified at the initial coordination meetings attended by representatives of FEMA, the study contractor, and the City of Point Arena on May 24, 25, and 27, 1983.

A reconnaissance and an information search were conducted to collect all existing information relevant to flooding in the detailed-study areas.

Engineering firms, residents, and business owners were interviewed at each of the detailed-study areas. The status of shore protection measures and the extent of recent coastal damage were noted.

Records of observed waves, atmoshperic pressures, and winds were obtained from the National Weather Service. The National Ocean Survey and the U.S. Geological Survey provided tidal records,

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bathymetric maps, and bench mark locations. Wave data records for state beaches on the northern California coast were obtained through the California Department of Boating and Waterways.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Point Arena, Mendocino County, California. The area of study is shown on the Vicinity Map (Figure 1).

Coastal flooding from the Pacific Ocean was studied in detail, beginning at the coastline approximately 600 feet north of the mouth of Point Arena Creek and extending south for a length of approximately 1,100 feet.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1989.

2.2 Community Description

The City of Point Arena is located along the southwestern coast of Mendocino County, in northwestern California. The city encompasses an area slightly in excess of 1.2 square miles. Point Arena is bordered by the Pacific Ocean to the west and unincorporated areas of Mendocino County to the north, east, and south.

Point Arena is a small coastal fishing community with a 1980 population of 425 (Reference 1). Fishing, tourism, and community services provide the economic base for Point Arena.

Elevations in the city range from sea level to over 280 feet. The community is drained to a great extent by Point Arena Creek, which flows easterly to its mouth at Arena Cove on the Pacific Ocean.

Arena Cove is an area of shallow water with a narrow outlet. The cove is surrounded by high cliffs. The headlands that lie due south of the cove and the offshore bathymetry protect this coastal area from high storm-generated waves.

Approximately 10 commercial buildings are situated near the mouth of Point Arena Creek. However, most houses and other buildings are built on the surrounding uplands.

The climate at Point Arena is dominated by the Pacific Ocean and is characterized by warm winters, cool summers, small daily and seasonal temperature changes, and high relative humidity. Annual precipitation totals of 30 to 40 inches are characteristic of northern California coastal areas (Reference 2).

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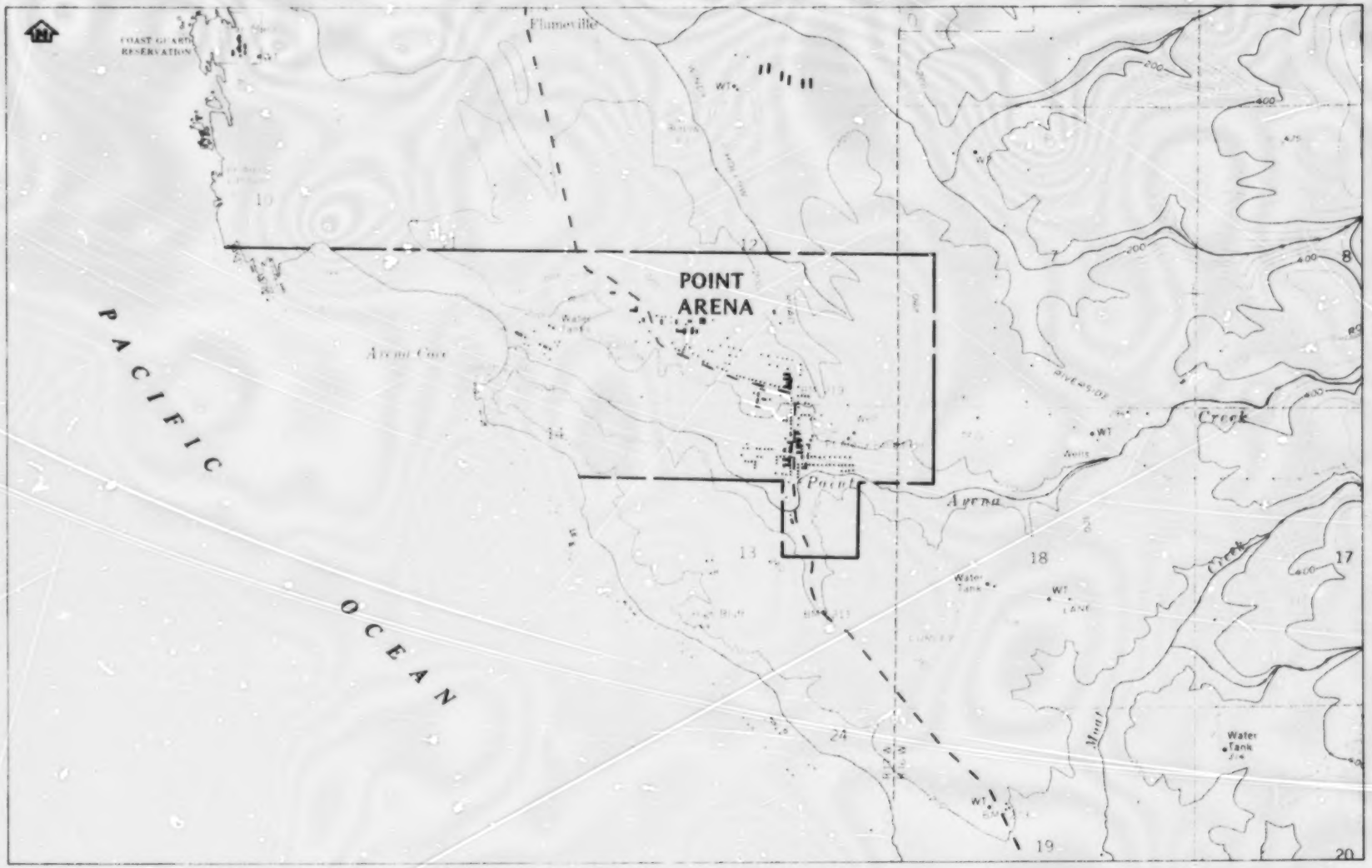

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF POINT ARENA, CA
(MENDOCINO CO.)

APPROXIMATE SCALE

2500 0 2500 5000 7500 FEET

VICINITY MAP

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2.3 Principal Flood Problems

Flooding along the Pacific coast at Point Arena is typically associated with the simultaneous occurrence of very high tides, large waves, and storm swells during the winter. As a result, ocean-front development has not been compatible with the natural instability of the shoreline and the intense winter weather conditions.

Tsunami (sea waves generated from oceanic earthquakes, submarine landslides, and volcanic eruptions) create some of the most destructive natural water waves. As tsunami waves approach shallow coastal waters, wave refraction, shoaling, and bay resonance amplify the wave heights.

Storm centers from the southwest produce the type of storm pattern most commonly responsible for the majority of the serious coastal flooding. The strong winds and high tides that create storm surges are also accompanied by heavy rains. In some instances, high tides back up riverflows, which causes flooding at the river mouth.

In the past, developed portions of the northern California coast have been damaged as a result of severe winter storms.

The most severe storms to hit the California coast occurred in 1978 and 1983, when high water levels were accompanied by very large storm waves.

In January 1978, a series of storms emanated from a more southerly direction than normally occurs; consequently, some of the better protected beaches in the area were also damaged.

The winter of 1983 brought an extremely unusual series of high tides, storm surges, and storm waves that cause damage along the northern California coast (Reference 2).

2.4 Flood Protection Measures

No structural or nonstructural flood plain management measures are in effect for the City of Point Arena.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, coastal hazard analyses were performed to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods,

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have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

Flood hazards along the northern California coast may be generated by swell waves from offshore storms, by wind waves from landfailing storms, or by tsunami. The degree of hazard depends on the water-surface elevation of the astronomical tide at the time of the wave or tsunami. To evaluate the flood hazards at Point Arena, detailed engineering studies separately defined the runup magnitude and frequency of astronomical tide plus swell waves arriving from both the northwest and southwest, the runup magnitude and frequency of tide plus wind waves arriving from both the northwest and southwest, and the magnitude and frequency of tide plus tsunami. These magnitude and frequency relations were statistically combined to provide a comprehensive evaluation of the coastal flood hazard at Point Arena.

Details of the engineering analyses are provided in Reference 2, and a summary of the analyses is presented in Section 3.1.

3.1 Coastal Hazard Analyses

Analyses were carried out to establish the peak elevation-frequency relationships for each flooding source studied in detail.

Swell-wave and wind-wave frequency and magnitude components were determined by a two-step process. The first step defined a stillwater elevation that included effects of astronomical tide, storm surge, and wave setup. The second step determined wave runup above the stillwater elevation onto the beach.

Storm surge is the superelevation of the water level above the astronomical tide elevation caused by the low barometric pressure and wind stresses of a storm. Storm surge was evaluated only for definition of the wind-wave component of landfalling storms. Setup is an additional superelevation of the water surface produced by wave action, and the magnitude of wave setup varies with wave characteristics, bathymetry, and beach profile. Because wave setup varies with the characteristics of the waves, different stillwater elevations and magnitude relations were defined for wind waves from the northwest, wind waves from the southwest, swell waves

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from the northwest, and swell waves from the southwest. Wave runup is the maximum elevation of a wave breaking onto a beach and varies with wave characteristics, bathymetry, and beach profile.

The storm surge at Point Arena was defined by a two-dimensional, finite-element computer model (Reference 3). Applicability of the model had been tested by using long-term climatic records for San Francisco (Reference 4) to synthesize a long-term record of storm surge hydrographs for San Francisco Bay. The close comparison of synthesized data with available tidal records confirmed the useability of the model for California storm conditions. For Point Arena, the model synthesized a record of storm surges from both the northwest and southwest quadrants based on windspeed, wind direction, and barometric pressure data, from 1955 to 1983, determined from North American Surface Weather Maps (Reference 5).

The effects of storm surge were combined with astronomical tide and wave setup to define the stillwater elevation needed to evaluate the wind-wave runup. Characteristics of astronomical tide at Santa Cruz could be reliably defined from previous studies (Reference 6) and were convoluted with storm surge (Reference 7). The magnitude of wind-wave setup was calculated by an iterative process coupled with the wave runup calculations.

Runup of wind waves was evaluated by first determining the deepwater wave conditions from both the southwest and northwest quadrants using the 1955-to-1983 climatic data and methods described in Reference 7. A wave tracking model (Reference 8) then transformed the deepwater waves as they traveled toward the shoreline, on the basis of bathymetry and beach profiles. Beach transects along the coast provided a generalized representation of the beach profiles, which control the magnitude of wave runup. In coastal-study areas, beach transects were oriented perpendicular to the shoreline and were strategically located along the shore to represent reaches with similar characteristics (See Figure 2). Data were primarily obtained from offshore bathymetry maps supplemented with 1978 COE survey data (Reference 9). Table 1 provides a listing of the transect locations and Figure 3 presents a sample transect. The wave runup along sloping sandy beaches was computed by Hunt's method (Reference 10); at obstructions, it was computed by Stoa's method (Reference 11).

The elevation-probability distribution for swell waves followed a similar development. Stillwater was defined only from wave setup convoluted with astronomical tide. The frequency of offshore wave height and wave period from the northwest and southwest quadrants were determined from available data (Reference 12) and routed shoreward with the wave tracking model. The runup elevation at each beach transect was calculated using Hunt's and Stoa's methods.

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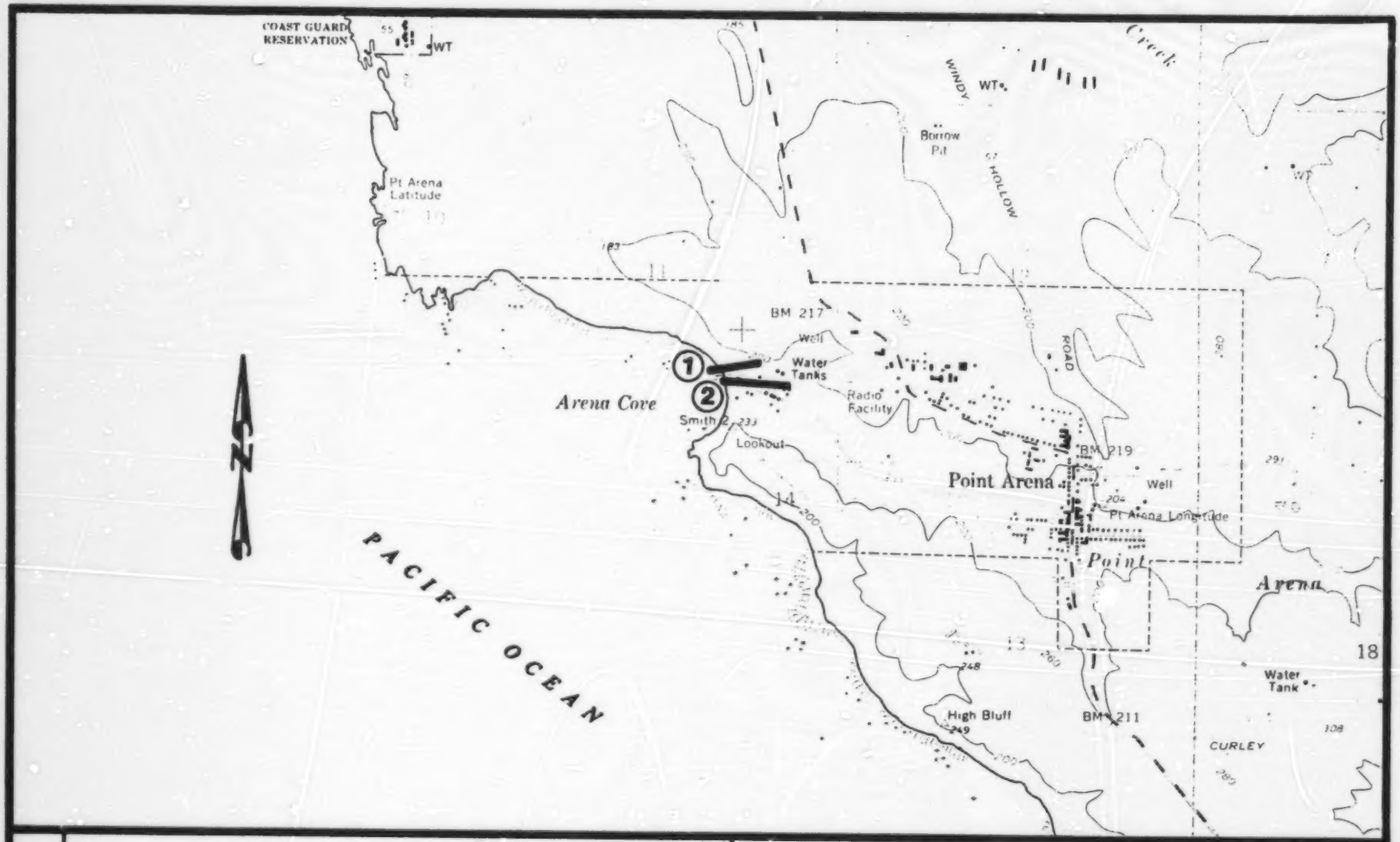

FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF POINT ARENA, CA
(MENDOCINO CO.)

APPROXIMATE SCALE IN FEET
1000 0 1000 3000 5000 7000

TRANSECT LOCATIONS

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Table 1. Transect Locations

Transect Number	Location
1	From the beach, east 170 feet to the launch ramp at the southwest corner of the boat house.
2	From the water's edge, 330 feet southeast to the upper end of the bridge.

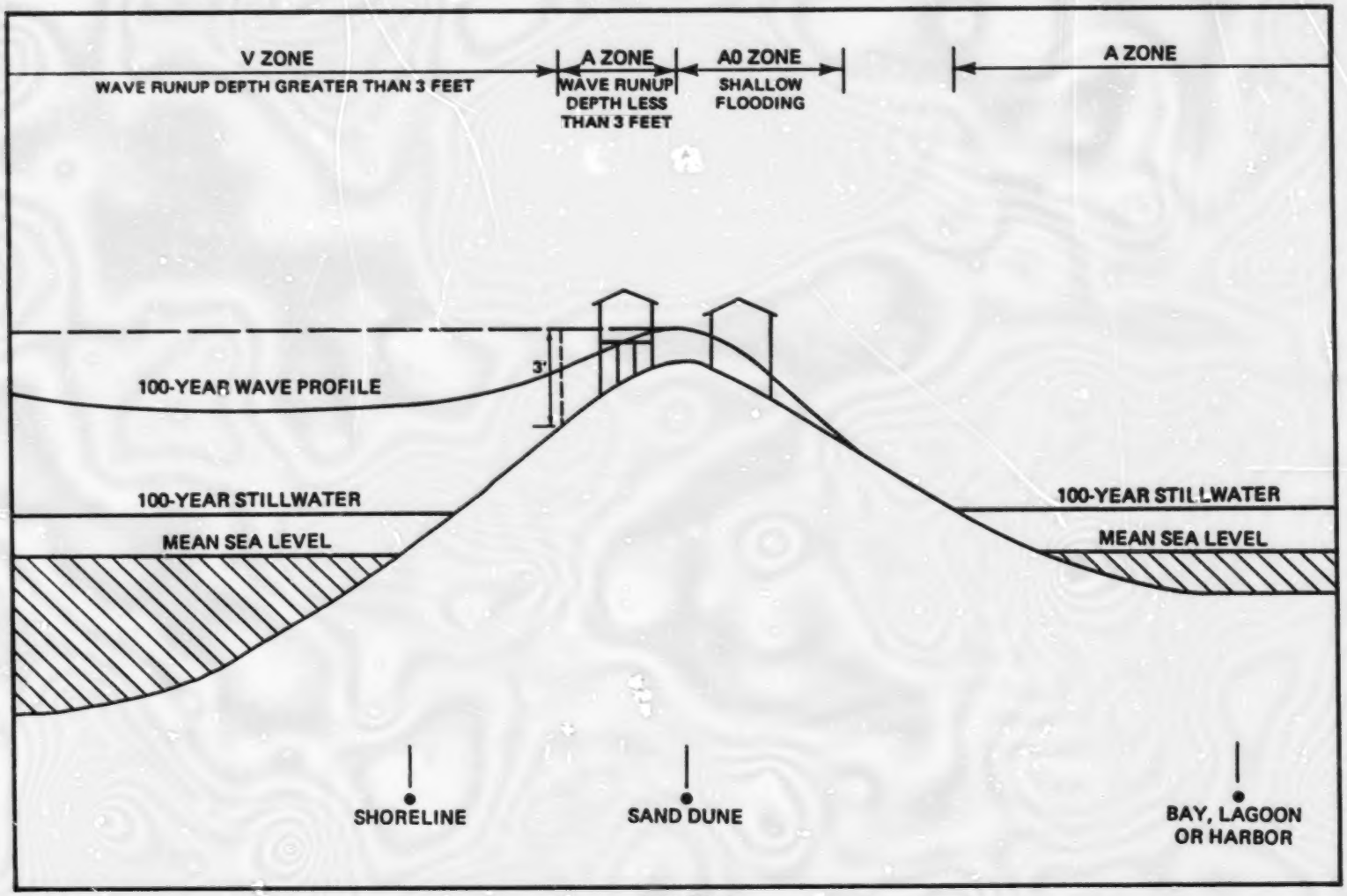

FIGURE 3
TYPICAL TRANSECT SCHEMATIC

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Tsunami plus astronomical tide elevations having 100- and 500-year recurrence intervals have been published (References 13, 14, and 15), and for the analysis at Point Arena, the complete magnitude-frequency relationship was defined from supporting data for those earlier studies.

The joint probability of wind waves from the northwest and southwest quadrants, swell waves from the northwest and southwest quadrants, and tsunami was defined on the assumption that the events are independent. Results of the analysis are shown in Table 2.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program (NFIP) encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the flooding source studied in detail, the 100- and 500-year flood plain boundaries have been delineated using a topographic map at a scale of 1:4,800, with a contour interval of 4 feet, developed from aerial photographs (Reference 16).

Approximate 100-year flood plain boundaries in some portions of the study area were taken directly from the effective Flood Insurance Rate Map dated August 3, 1984 (Reference 17).

Flood plain boundaries are indicated on the Flood Insurance Rate Map (Exhibit 1). On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and V7); and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards (Zone B). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or each of detailed topographic data.

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Table 2. Summary of Stillwater Elevations

Flooding Source and Location	Stillwater Elevation (Feet) 10-Year	50-Year	100-Year	500-Year
Pacific Ocean				
At Point Arena	5.3	5.7	5.8	6.1

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5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for the flooding source studied in detail affecting the City of Point Arena.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard. In tidal areas, reaches are limited to the distance for which the 100-year flood elevation does not vary more than 1.0 foot. Using these criteria, one reach was required for the flooding sources of the City of Point Arena. The location of this reach is shown on the Flood Insurance Rate Map.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10-and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone V7:	Special Flood Hazard Areas along coasts inundated by the 100-year flood that have additional velocity hazards associated with waves of 3-foot amplitude or greater; with base flood elevations shown, and zones subdivided according to FHFs.

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Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Point Arena is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

Because of the more detailed analyses performed, this Flood Insurance Study supersedes the previously printed Flood Insurance Rate Map for Point Arena, dated August 3, 1984 (Reference 17).

A revised Flood Insurance Study is being prepared for the unincorporated areas of Mendocino County (Reference 18). The results of this study will match exactly the results of the Mendocino County study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Building 105, Presidio of San Francisco, San Francisco, California 94129.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (METERS MSL)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Pacific Ocean Reach 1	0005	-3.3	-1.2	3.0	035	V7	20

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF POINT ARENA, CA
(MENDOCINO CO.)

FLOOD INSURANCE ZONE DATA

PACIFIC OCEAN

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